REMARKS

Claims 1-7 are pending.

Claims 4-6 stand rejected under 35 USC §112, second paragraph, as being allegedly indefinite for failing to particularly point out and distinctly claim the subject matter that the Applicant regards as the invention.

Claims 1-3 stand rejected under 35 USC §102(b) as being allegedly anticipated by either Kosmahl references (US 3,764,850, US 4,395,656).

Claims 4, 5, and 7 stand rejected under 35 USC §102(b) as being allegedly anticipated by Satou (JP 48151), Nelson et al (US 3,832,596), or Berwick (US 4,387,323).

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "**VERSION WITH MARKINGS TO SHOW CHANGES MADE.**"

Changes in the Specification:

The specification has been amended for the purpose of improving the readability of the application and are of a clerical, typographical or grammatical nature. No new matter has been added.

The paragraph beginning at page 5, line 16 has been amended to designate FIG. 5 as prior art since FIG. 5 references FIG. 1 as prior art.

The phrase "not evenly dispersed" at page 11, line 5, has been replaced with "become refocused electron beam 125".

The phrase "of the present invention" at page 12, line 1, has been deleted.

The phrase "a return plate 153 connects both magnetic fields 152 and 154" has been added to support the "return plate" in FIG. 10.

The phrase "centerline (CL)" has been added to the paragraph beginning at page 10, line 11 for supporting the reference label "CL" in FIGS. 1, 7-9.

The paragraph beginning at page 10, line 8 has been amended to provide support for reference labels 125, 139, 140, 142, and AIR on FIG. 9.

The paragraph beginning at page 12, line 1 has been amended to provide support for reference label "R" in FIGS. 1 and 7.

The paragraph beginning at page 13, line 11 has been amended to provide support to reference labels "18" and "20" in FIG. 3.

Drawing label "126" in FIG. 10 is supported by the description at page 9, line 18.

Changes in the Drawings:

The drawings have been amended in response to the Examiner's request for the purpose of overcoming the Examiner's objection. Specifically, descriptive on drawings have been deleted in FIGS. 1-7, 9-10.

In FIGS. 1-7, the descriptive on these drawings have been entirely deleted.

In FIGS. 1-2, 5, 9, 10, the designation "PRIOR ART" has been added.

In FIG. 10, label "152" has been renumbered to label "153" to refer to the return plate.

Applicant therefore requests that the objection to the Drawings be withdrawn. No new matter has been added. Approval of the corrections is respectfully requested.

Changes in the Claims:

Claims 1-2, 4, 7 have been amended or added in this application to further particularly point out and distinctly claim subject matter regarded as the invention. No new matter has been added.

Claim 1 has been amended to rephrase "being constructed" with – having a configuration – as suggested by the Office Action.

Claim 2 has been amended to delete "the region of" and add – is defined by a region which – as suggested by the Office Action.

Claim 4 has been amended to replace "formed" with –configured -- as suggested by the Office Action.

Claim 7 has been amended to replace "forming" with – providing -- as suggested by the Office Action.

Rejection under 35 USC §112, second paragraph – claims 4-6

Claims 4-6 stand rejected under 35 USC §112, second paragraph, as being allegedly indefinite for failing to particularly point out and distinctly claim the subject matter that the Applicant regards as the invention. This rejection is respectfully traversed.

MPEP §2171 identifies two separate requirements: (1) the claims must set forth the subject matter that applicants regard as their invention; and (2) the claims must particularly point out and distinctly define the meets and bounds of the subject matter that will be protected by the patent grant. A lack of antecedent basis may be found if a claim

is "indefinite" because "it contains words or phrases whose meaning is unclear"; see MPEP §2173.05(e).

The Office Action alleges that the term "second open pole pieces" in claim 4 is unclear. Claim 4 has been amended to delete "second" from this term. The claims now meet the statutory requirements.

Rejection under 35 USC §102(b) – claims 1-3

Claims 1-3 stand rejected under 35 USC §102(b) as being allegedly anticipated by either Kosmahl reference (US 3,764,850, US 4,395,656). This rejection is respectfully traversed.

A claim must be anticipated for a proper rejection under §102(a), (b), and (e). This requirement is satisfied "only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference"; see MPEP §2131 and *Verdegaal Bros. V. Union Oil*, 814 F.2d 628, 2 USPQ2d 1051 (Fed. Cir. 1984). A rejection under §102(b) may be overcome by showing that the claims are patentably distinguishable from the prior art; see MPEP §706.02(b).

Kosmahl ('850) teaches a first solenoid (24) for producing a first magnetic field and a second solenoid (27) for producing a second magnetic field **adjacent** to the collector region (13).

Kosmahl ('656) teaches a gyrotron (10) and a multi-stage depressed collector (11). The gyrotron (10) includes a first solenoid (14) generating a first magnetic field (15), a second solenoid generating a refocusing field (21), and a focusing ring (18) made of magnetic material. Both second solenoid and focusing ring (18) are disposed **adjacent**

to the collector (11). In particular, the focusing ring (18) is located at the entrance of the collector (11).

In contrast, the presently claimed invention claims a magnet surrounding an anode, and "a collector for receiving the collimated electron beam and for returning the electrons to the cathode, said collector is a multi-stage depressed collector which is shielded from the magnetic field from said magnet, **said magnet only disposed at an end of said anode opposite to said collector**." Neither Kosmahl ('850) nor Kosmahl ('656) teach a magnet only disposed at an end of the anode **opposite** to the collector. Instead, both Kosmahl ('850) and ('656) teach having a second solenoid generating a magnetic field **adjacent** to the collector, and a second solenoid and a focusing ring **adjacent** to the collector respectively.

The presently claimed invention is, accordingly, distinguishable over the cited reference. In the view of the foregoing, it is respectfully asserted that claims 1-3 are now in condition for allowance.

Rejection under 35 USC §102(b) – claims 4-5, 7

Claims 4-5, and 7 stand rejected under 35 USC §102(b) as being allegedly anticipated by Satou (JP 48151), Nelson et al (US 3,832,596), or Berwick (US 4,387,323). This rejection is respectfully traversed.

Satou discloses a klystron having a permanent magnet (6) at the electronic gun side and a permanent magnet (7) at the collector side.

Nelson discloses a klystron having pole pieces (18) and (19) magnetically energized by permanent magnets (21) and (22) disposed surrounding pole pieces (18) and

(19) respectively. Col. 3, lines 38-42. Permanent magnet (21) is near to the electron gun assembly (12). FIG. 1. Permanent magnet (22) is adjacent to the collector (14). FIG. 1

Berwick discloses an electron tube with a magnetic material (10') at "the end of the structure farthest removed from collector (24)". Col. 3, lines 30-32; FIG. 2. Fins (26) are attached to the outside of a single stage collector (24) to dissipate heat. Col. 2, lines 63-65.

In contrast, the presently claimed invention claims a magnet surrounding and focusing a narrow beam. The magnet has open pole pieces along the centerline of the electron beam to focus and drive the electron beam. An open pole piece is adjacent to the area of the source of electrons to initially focus the electron beam. The magnet has **no open pole pieces** in the vicinity of the **multi-stage depressed collector** so that any magnetic flux from the magnet is directed back into the body of the magnet. Claim 4.

Instead, Satou teaches a permanent magnet (7) **at** the collector side. Similarly, Nelson teaches a permanent magnet (22) **adjacent** to the collector (14). Also, Berwick teaches a **single stage** collector (24) as opposed to the claimed multi-stage depressed collector.

The presently claimed invention is, accordingly, distinguishable over the cited references. In the view of the foregoing, it is respectfully asserted that claims 4-5, 7 are now in condition for allowance.

Conclusion

For all of the above reasons, applicant submits that the amended claims are now in proper form, and that the amended claims all define patentability over the prior arts. Therefore, Applicant submits that this application is now in condition for allowance.

Request for allowance

It is believed that this Amendment places the above-identified patent application into condition for allowance. Early favorable consideration of this Amendment is earnestly solicited. If, in the opinion of the Examiner, an interview would expedite the prosecution of this application, the Examiner is invited to call the undersigned attorney at the number indicated below.

Respectfully submitted,
THELEN REID & PREIST LLP

Dated: September 3, 2002

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

The paragraph beginning at page 5, line 16 has been replaced with the following paragraph:

-- Figure 5 is a drawing simulation of electrons entering the collector region in the presence of a magnetic field reversal for a system as set forth in conjunction with Figure 1 in accordance with a prior art; --

The paragraph beginning at page 7, line 7 has been replaced with the following paragraph:

-- The klystron tube 100 in Figure 10 is a device for amplifying signals 102 at microwave radio frequencies. The high velocity electron beam emitted from the cathode 104 passes through the anode 106 and into the RF interaction region 108. An external magnetic field is employed to prevent the beam from spreading as it passes through the klystron. Magnet 150 supplies the strong magnetic field 152, 154 in a clockwise direction as Figure 10 is viewed. Magnet 150 is cylindrical and surrounds parts of the cathode, anode, and parts of the collector, but only a top section view of the magnet is shown for clarity. A return plate 153 connects both magnetic fields 152 and 154. At the other end of the klystron, the electron beam impinges on the collector electrode 120, which dissipates the beam energy and returns the electron current to the beam power supply 122. --

The paragraph beginning at page 10, line 11 has been replaced with the following paragraph:

-- In an ideal situation, the electron flow 124 enters the collector chamber 138 of the collector 120 with a centerline (CL) as seen in Figure 8. As the electrons enter the chamber 138 and the magnetic field is removed, the natural electrostatic repulsion of the electrons will cause them to scatter to impinge upon the walls 139 evenly as shown internally of the chamber in Figure 8. The fins 140 are shown for cooling, with air 142 forced over the fins 140 to remove the heat caused by the energy of the impinging electrons being converted from kinetic energy to heat energy. --

The paragraph beginning at page 10, line 18 has been replaced with the following paragraph:

-- In an actual collector for a klystron, there is normally some extraneous magnetic field action within the chamber 138 defined internally of the collector 120 with a centerline (CL) as seen in Figure 9 no matter how effective the shielding. Figure 9 illustrates the walls 139 of the chamber 138. The fins 140 are also shown for cooling, with air 142 forced over the fins 140 to remove the heat caused by the energy of the impinging electrons being converted from kinetic energy to heat energy. While it is not intended generally for the chamber 138 of the klystron collector 120 to be affected by the magnetic field, the prior art has not been successful in eliminating the effects of the magnetic flux reversal at the point where the electron beam enters the chamber 138 of the collector 120. The electron path 124 in Figure 9 does not result in a pure fan shaped dispersion of the electron beam as seen in Figure 8, but the electrons have a tendency to

be refocused again within the collector chamber 138 by the flux reversals of the magnetic field, although unintended. Figure 9 shows that the electron beam 124 [is not evenly dispersed] become refocused electron beams 125 in the collector 120[, but has a tendency to refocus the beam so that it is]. The refocused electron beam 125 are collected in a smaller area of the chamber, shown to be accumulated at the inner end of chamber 138. With the electrons impinging on the collector in a smaller area, a designer must take into effect the possibility of hot spots caused by an over abundance of impinging electrons in that one area. --

The paragraph beginning at page 12, line 1 has been replaced with the following paragraph:

-- Figure 1 [of the present invention] shows a conventional permanent magnet arrangement 10 for use in a typical klystron tube. The line 12 at the bottom of Figure 1 is actually the centerline (CL) of the magnet depicted. That is, the magnet 10 shown in Figure 1 is actually circular about the centerline with only a plan section view of one-half of the magnet illustrated. The vertical axis of Figure 1 represents the dimension or radius (R) of the magnet 10. On the left side of the magnet is the area 14 of the magnet that is used to initially begin the focusing of the electron beam into a narrow pencil beam. The direction of the magnetic field at the area of the magnet adjacent the gun magnet 16 is toward the bottom of the magnet with the magnetic fields returning in the drawing to the other pole of the magnet at the top of Figure 1. The electrons are confined along the centerline 12 of the high-energy tube by the magnetic flux field allowing for improved energy recovery of the electron beam. --

The paragraph beginning at page 13, line 11 has been replaced with the following paragraph:

-- Figure 3 [of the present invention] shows a similar drawing to that of Figure 1, except now there is magnetic material at the collector region 30 of the permanent magnet 32. The permanent magnet 32 has a magnetic field 18 which traverses the opening 20 at the area where the electron beam is modulated. This magnetic material eliminates the effects of any flux reversal which appeared and was described above conjunction with Figures 1 and 2. In Figure 3, the magnetic field lines are terminated into the magnetic metal of the magnet at collector region 30. --

In the Claims:

1. (Once Amended) A high power output vacuum electron device comprising:

a cathode for emitting a supply of electrons,

an anode for attracting said electrons, said anode [being constructed] having a configuration to allow said electrons to pass through said anode,

an RF generator circuit in the path of said electron beam for generating RF signal energy in the presence of a high-voltage power source,

a magnet surrounding said anode and said RF generation circuit for focusing said electrons into a collimated beam, and

a collector for receiving the collimated electron beam and for returning the electrons to the cathode, said collector is a multi-stage depressed collector which is

shielded from the magnetic field from said magnet, said magnet only disposed at an end of said anode opposite to said collector.

2. (Once Amended) The vacuum electron device of Claim 1 wherein [the region of] said collector is defined by a region which is free of any magnetic fields such that the electron beam naturally disperses to evenly deposit said electrons on [the] inner walls of said collector, said collector being thereby free of hot spots due to uneven electron deposition thereon.

3. (Not Amended) The vacuum electron device of Claim 1 wherein said collector is free of magnetic flux reversals from said magnet such that the electron beam evenly disperses on said collector.

4. (Once Amended) A vacuum electron device including a source of electrons, said electrons being [formed] configured into a narrow beam, and a multi-stage depressed collector for collecting said electrons, the improvement comprising:

a magnet surrounding and focusing said narrow beam, the magnetic flux of said magnet being parallel to and collinear with the centerline of said electron beam, said magnet having open pole pieces along said centerline to focus and drive said electron beam, said magnet having [second] open pole pieces adjacent to the area of said source of electrons to initially focus said electron beam, said magnet having no open pole pieces in the vicinity of said multi-stage depressed collector so that any magnetic flux from the magnet is directed back into the body of said magnet.

5. (Once Amended) The vacuum electron device of Claim 4 wherein said multi-stage depressed collector includes an internal chamber, said electrons evenly dispersing within said internal chamber thereby eliminating any hot spots due to magnetically focused electrons.

6. (Once Amended) The vacuum electron device of Claim 5 wherein [said collector comprises a multi-stage depressed collector,] each of said stages [being] is connected to a different high-voltage supply such that electrons of different kinetic energies will impinge on the associated depressed collector.

7. (Once Amended) A gun only magnet utilized in a multi-stage depressed collector high-energy vacuum electron device comprising:

a first pole piece region generating magnetic flux adjacent a cathode of said vacuum electron device to drive and initially focus electrons emitted from said cathode, and

a second pole piece region [forming] providing magnetic flux along the path of electrons to focus said electrons into a narrow beam, said magnet having no pole piece in the region of said vacuum electron device where the electrons are collected and returned to said cathode.

Gun-Only Magnet used for a Multi-Stage Depressed Collector (MSDC) Klystron

Description:

The goal of our effort is to develop a permanent magnet (PM) focused MSDC klystron. The limitation encountered when adapting MSDC technology to conventional permanent magnet focused klystrons is electron beam refocusing in the collector due to magnetic field reversals (see figures 1 and 2). To overcome this limitation imposed on klystrons that utilize PM focusing systems with conventional collectors, the internal volume of the collector is minimized. Minimizing the collector volume has the effect of limiting the maximum beam power that can be handled safely, and hence limits the maximum output power of the device.

The MSDC requires a much larger internal volume than its non-depressed counterpart and is more sensitive to stray magnetic fields within the collector region (see figures 3 and 4). Conventional PM focusing systems will not work for high efficiency MSDC klystrons exactly for this reason. The key in making an MSDC PM focused klystron is using a circuit which has no field reversals in the collector region. The Gun-Only magnet is the key to successful PM MSDC klystron technology and it is the idea of using the Gun-Only magnet approach for this application that is novel.

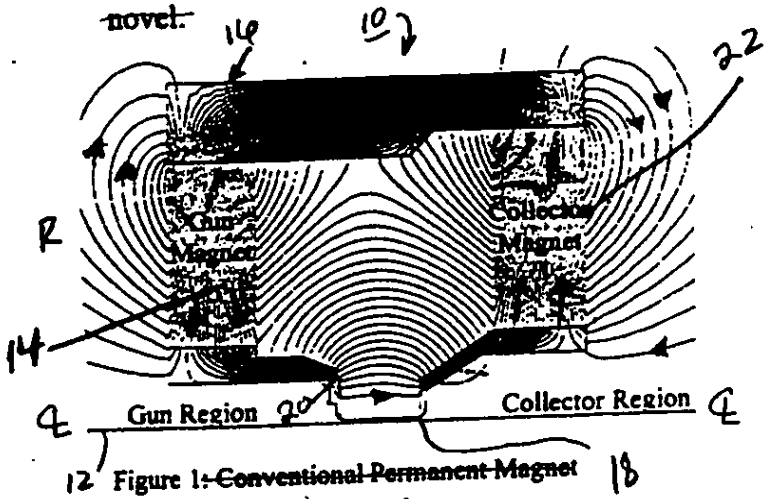

Figure 1: Conventional Permanent Magnet

PRIOR ART

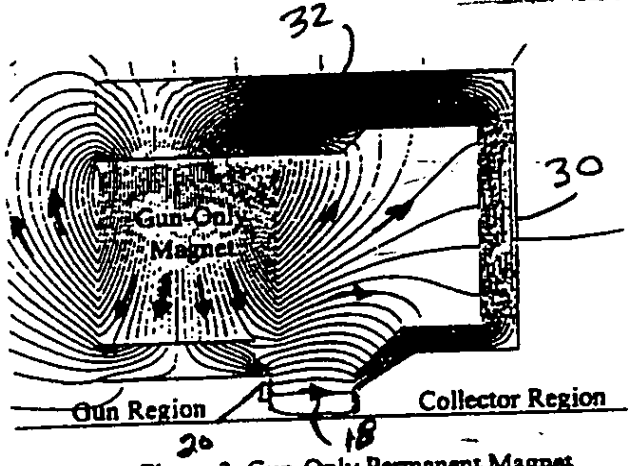

Figure 3: Gun-Only Permanent Magnet

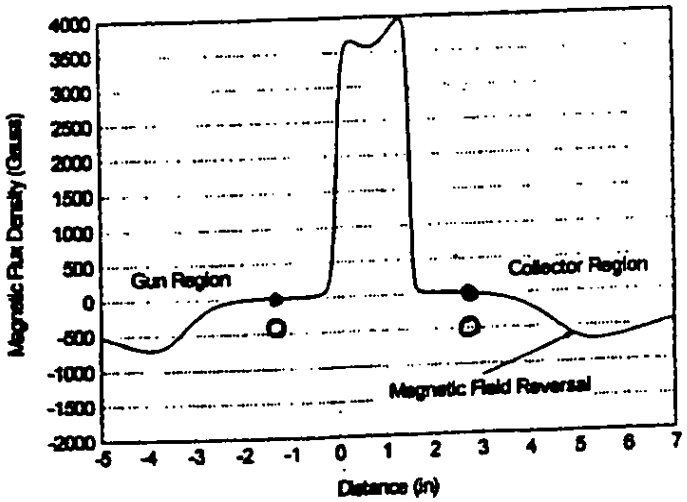

Figure 2: Conventional Permanent Magnet On-Axis Magnetic Flux Density. Notice the magnetic field reversal in the collector region.

PRIOR ART

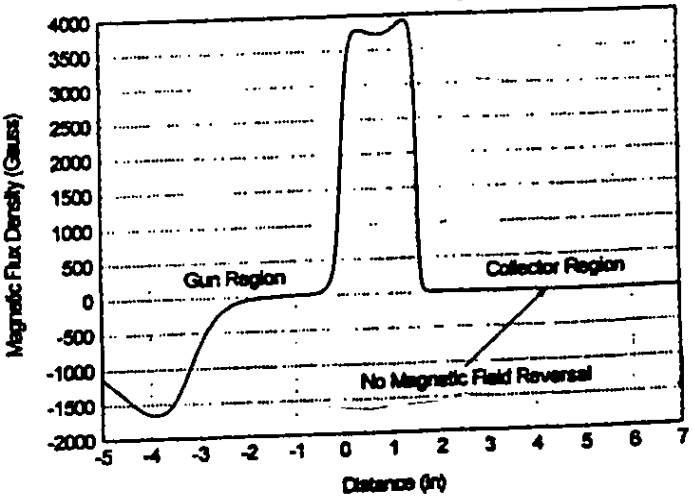

Figure 4: Gun-Only Permanent Magnet on-axis magnetic flux density. This PM circuit has no field reversal in the collector.

Description, Cont.:

The refocusing experienced by electrons as they enter the collector region in the presence of a magnetic field reversal can be seen in figure 5. Notice that many of the particles move radially outward, and are turned back towards the axis by the magnetic field. A simulation for the same collector, but with the Gun-Only magnet, can be seen in figure 6. Note the monotonic increase in radius of the particles as they impinge the collector. Simulation of a three (3) stage MSDC using the Gun-Only approach can be seen in figure 7.

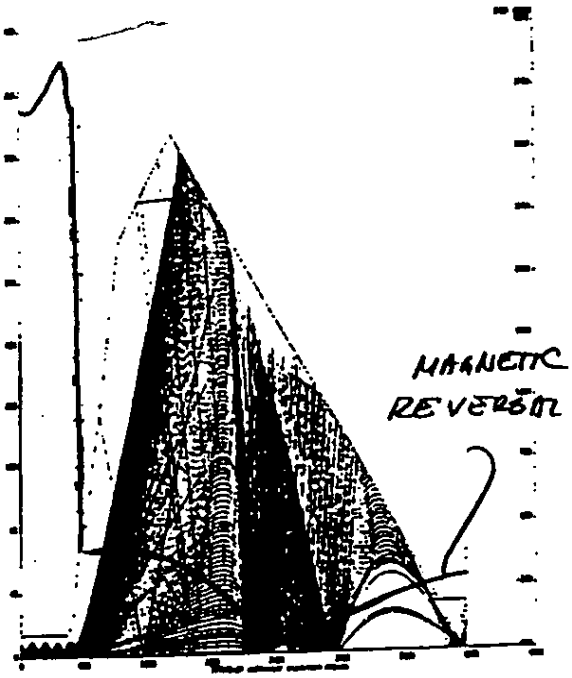

Figure 5: Simulation of electrons entering the collector region in the presence of a magnetic field reversal. PRIOR ART

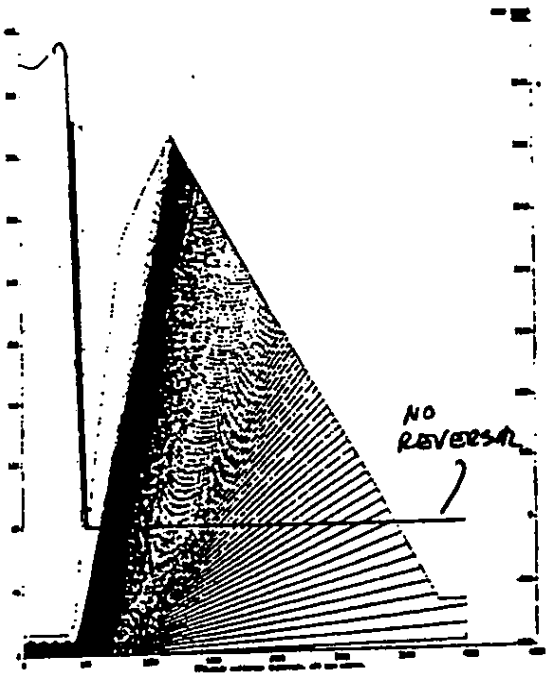

Figure 6: Simulation of electrons entering the collector region in the absence of a magnetic field reversal by use of a Gun-Only magnet.

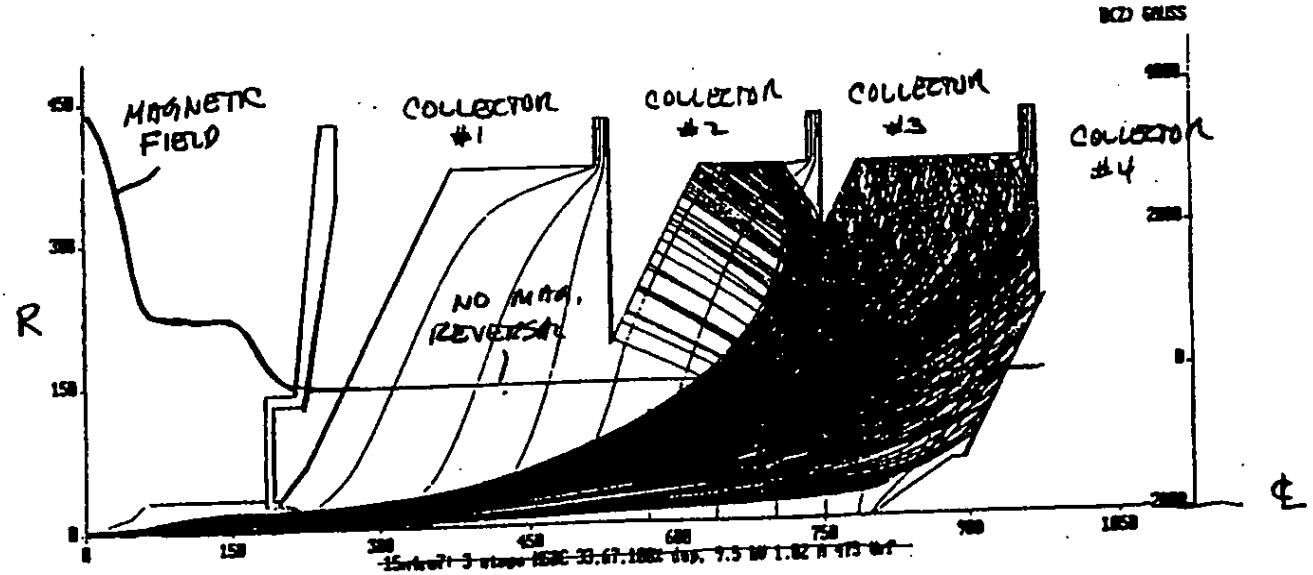

Figure 7: Simulation of electrons entering a three (3) stage MSDC collector.

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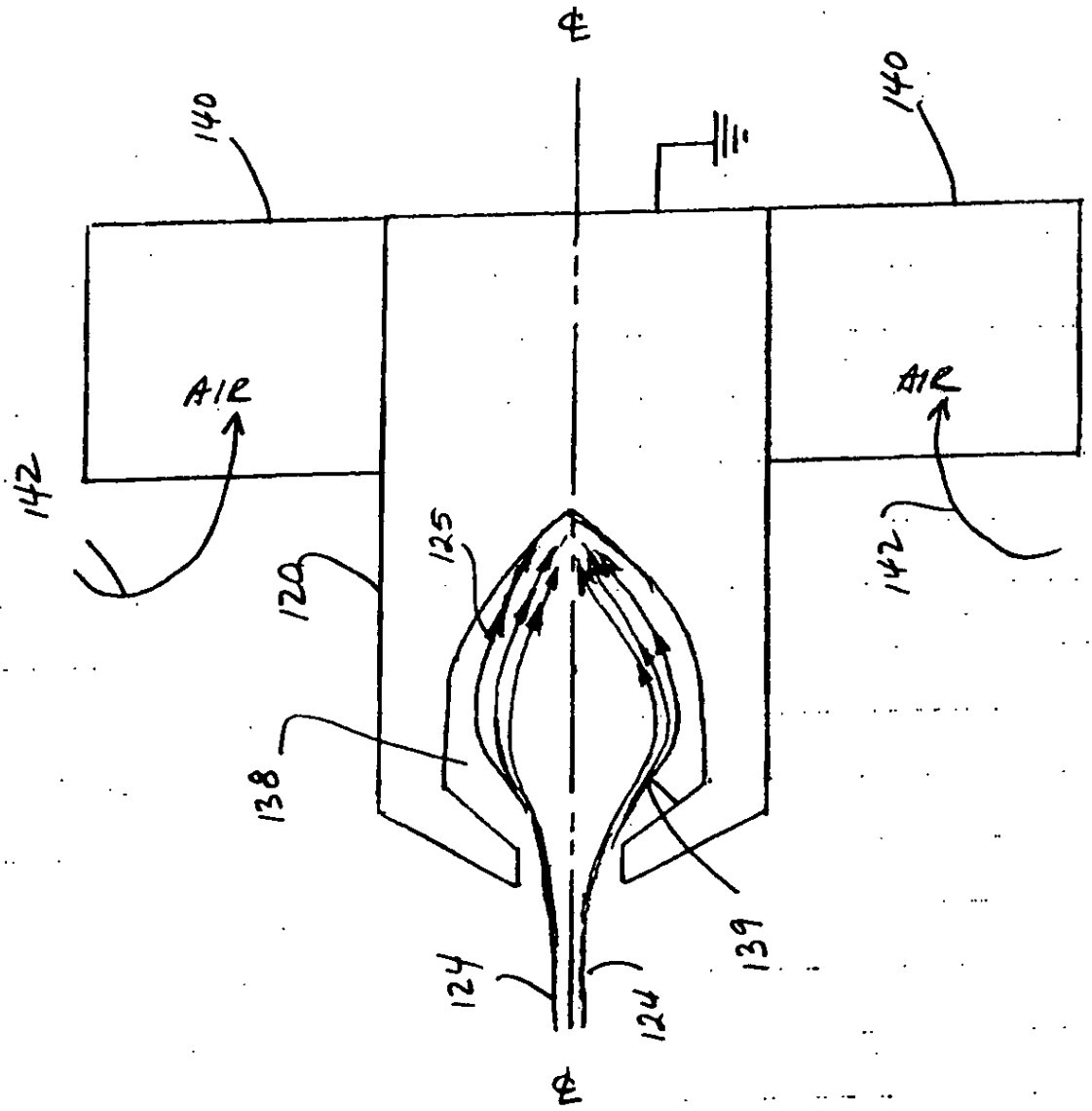
FIG. 9
PRIOR ART



The Klystron Layout

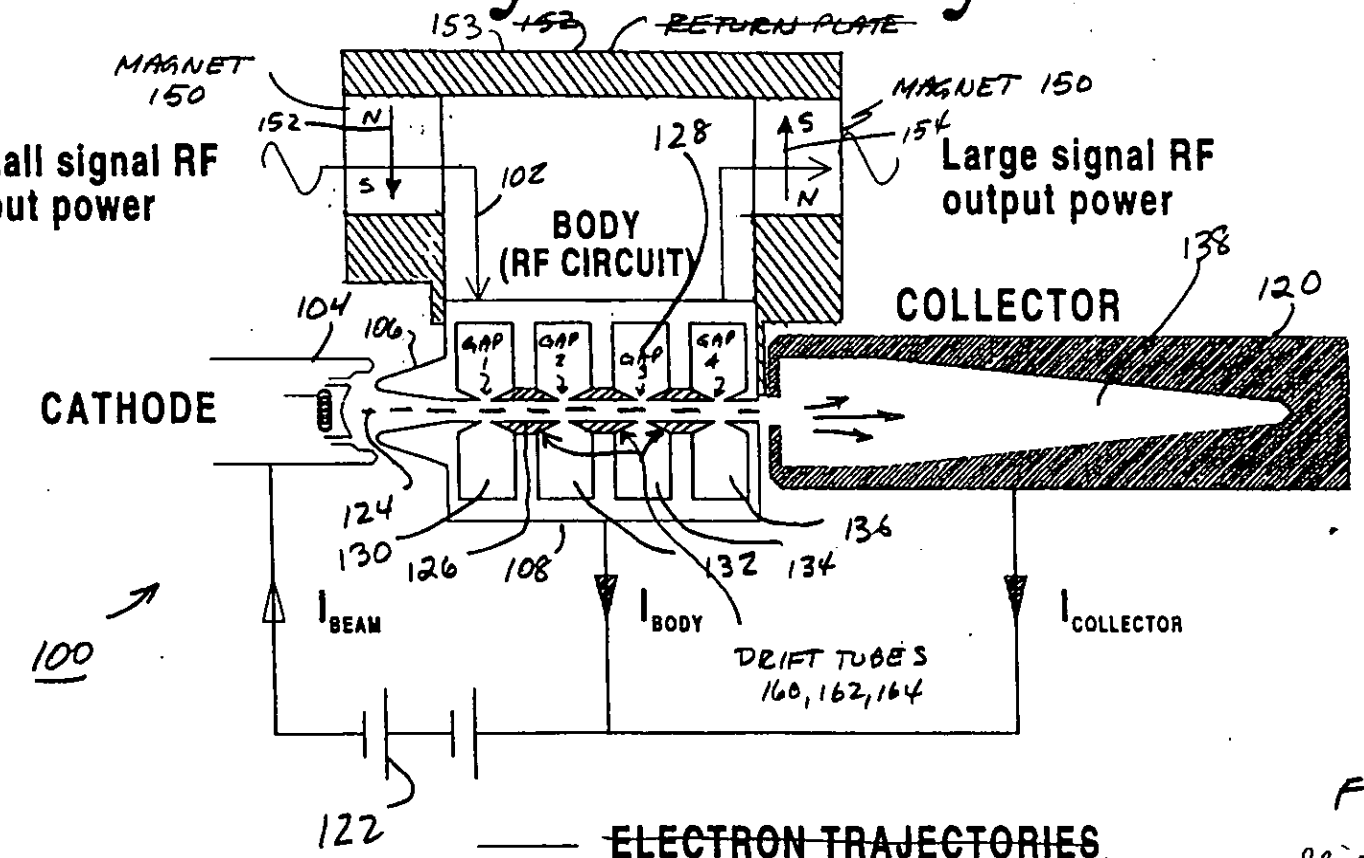


FIG. 10
PRIOR ART

CURRENTS ARE SHOWN AS ELECTRON FLOWS
NO HEATER SUPPLY SHOWN

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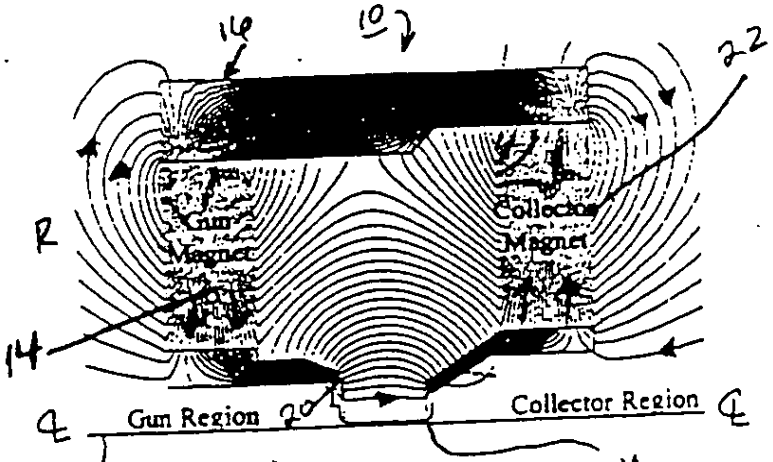

Figure 1 PRIOR ART

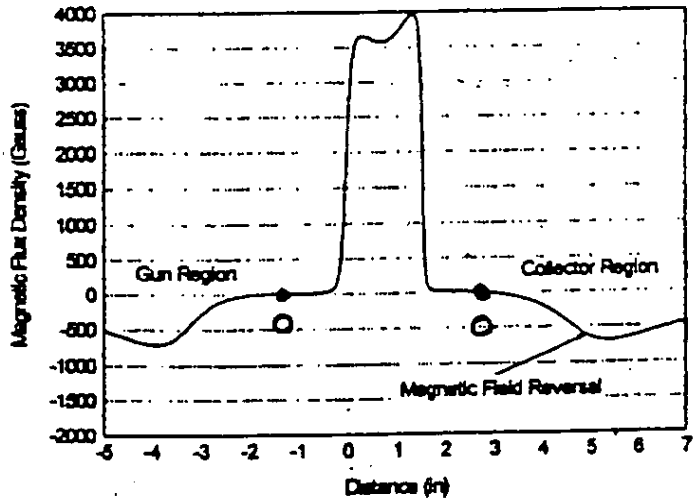

Figure 2 PRIOR ART

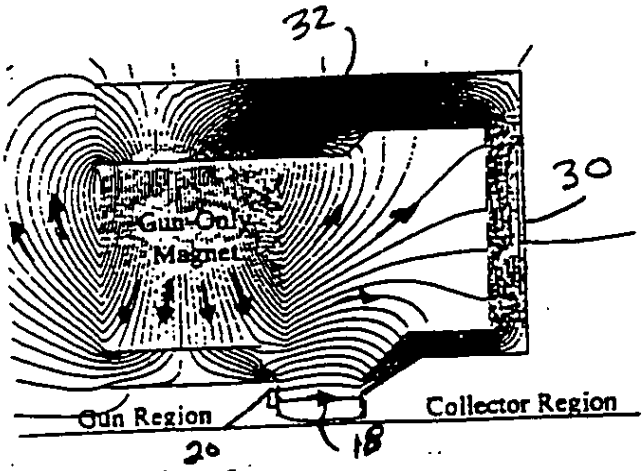

Figure 3

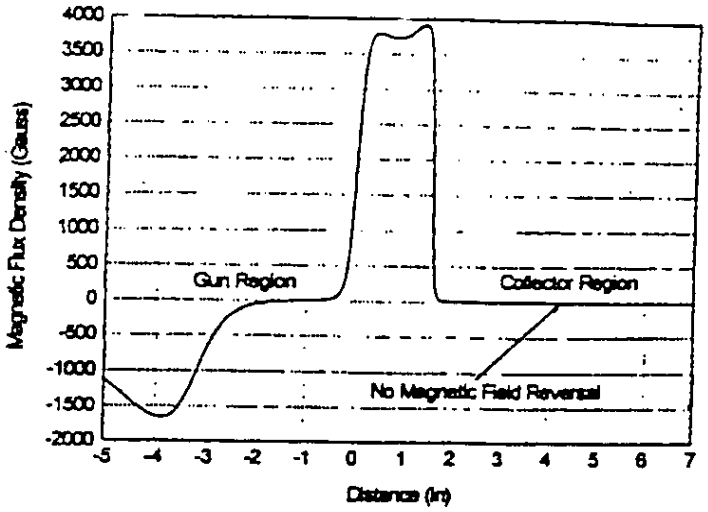

Figure 4:

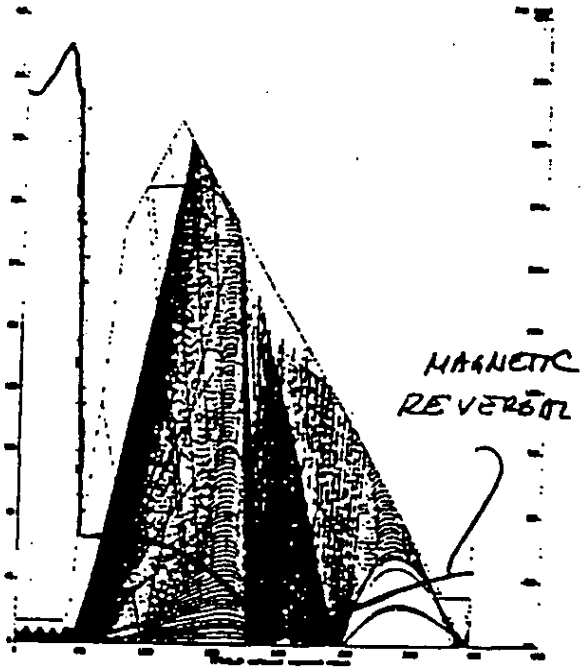

Figure 5 PRIOR ART

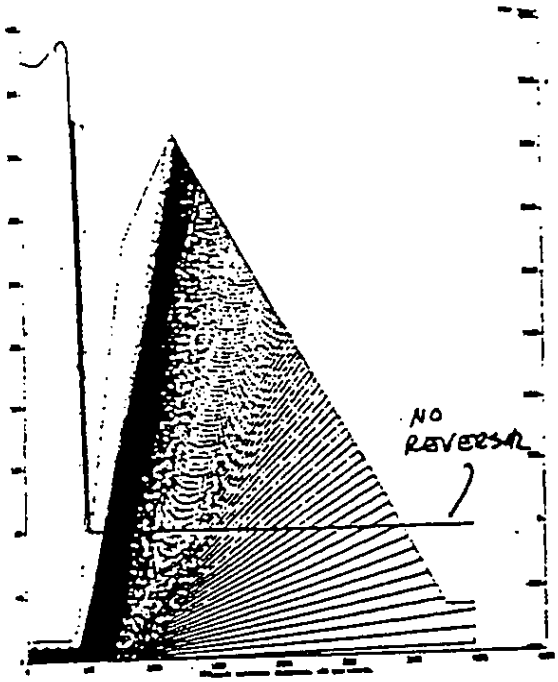

Figure 6

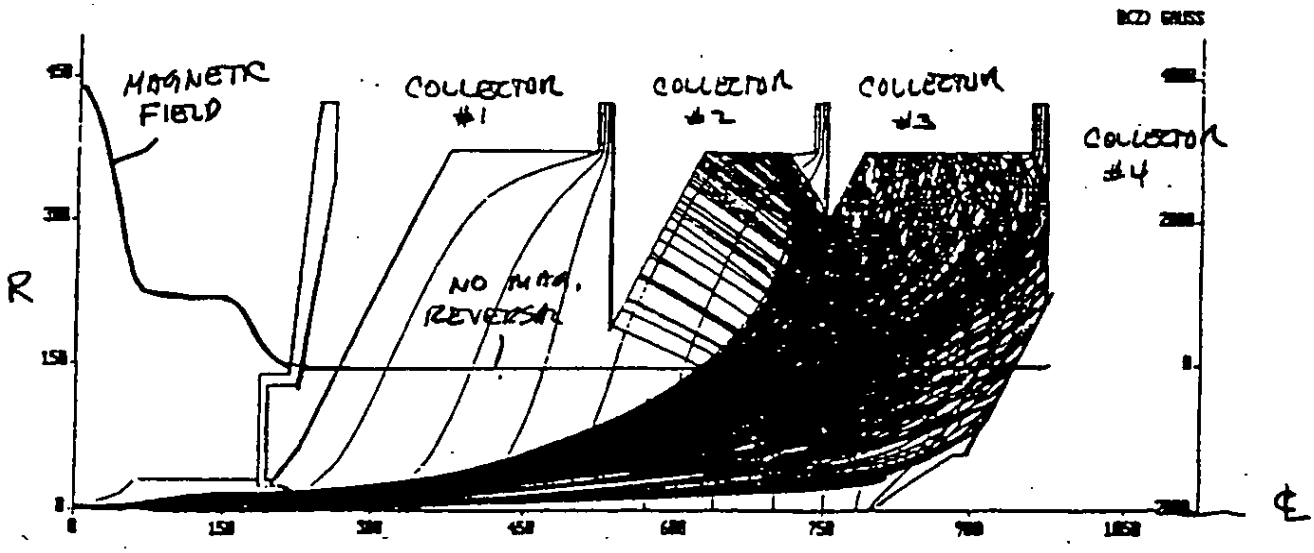

Figure 7

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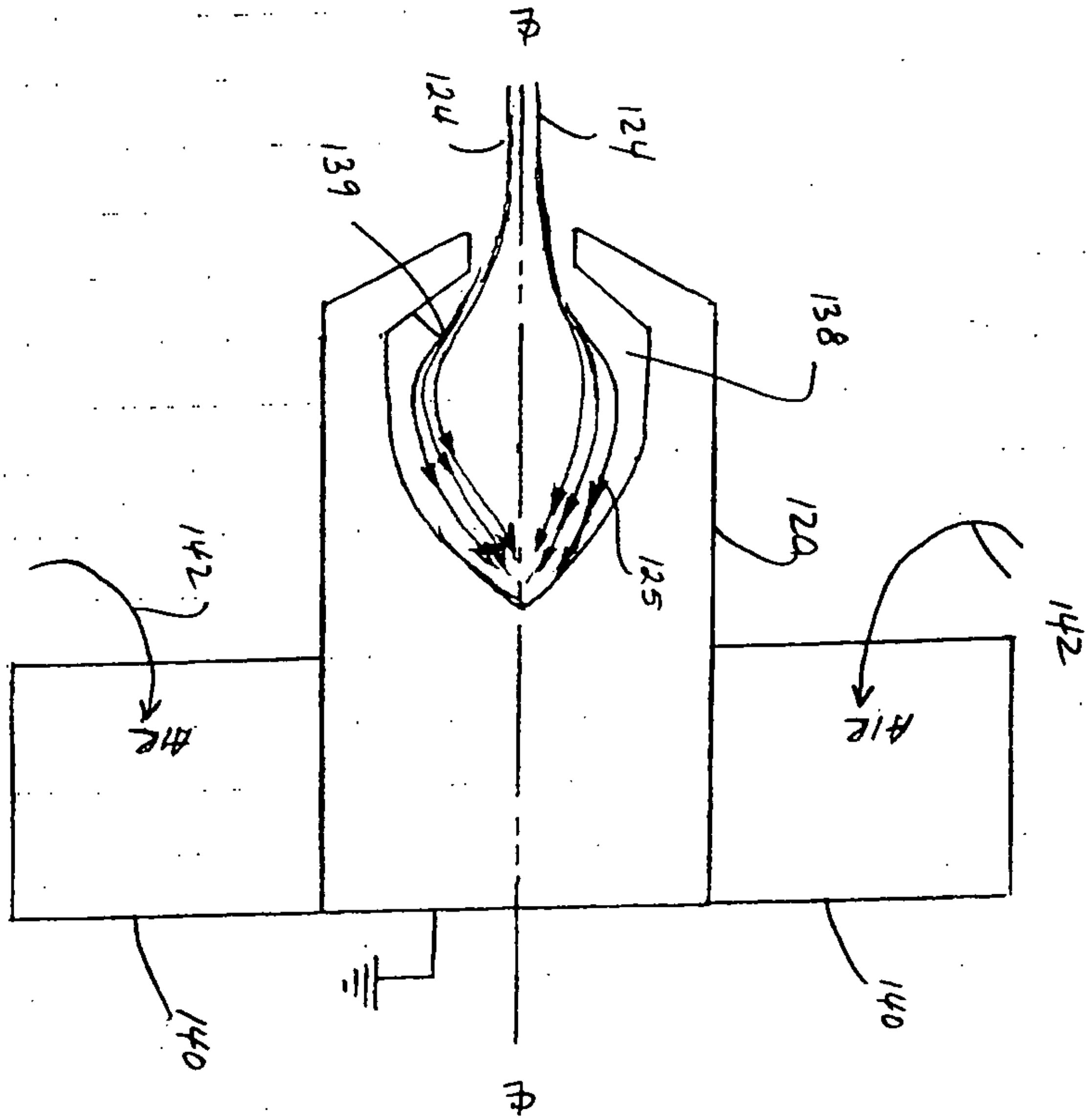

FIG. 9
PRIOR ART

The Klystron Layout

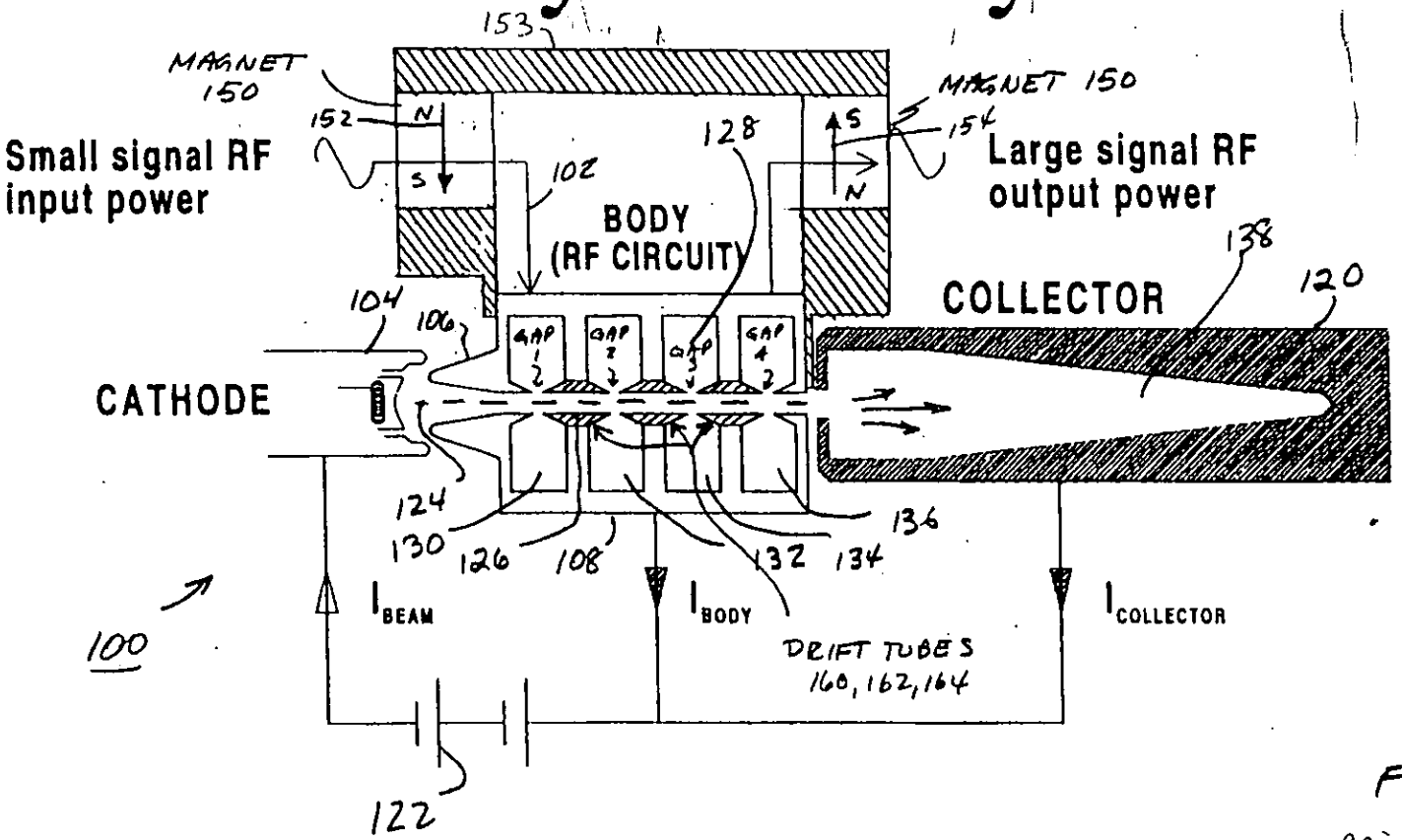

FIG. 10
PRIOR ART

FIG. 8